Rebuild Michigan

Energy Services

Introductory Energy Evaluation

Bedford Falls Public Schools
Bedford Falls, Michigan

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Executive Summary

On September 3, 2003, a walk-through audit was conducted in the buildings of Bedford Falls Public Schools to identify opportunities for reducing energy consumption and costs. The walk-through of each building consisted of a visual inspection of electrical, mechanical and HVAC equipment, temperature controls, and lighting. An analysis was also made of the buildings' energy use based on information obtained for each facility.

From the results of this Introductory Energy Evaluation, a Comprehensive Technical Energy Analysis (CTEA) conducted by a qualified engineering firm is recommended as your next step. A summary of energy conservation opportunities (ECOs) is included in this report. Although some of the listed ECOs such as lighting, timers and computer software can be readily implemented by your maintenance and technology staff, other ECOs require a more significant investment and should be appropriately analyzed. Among major ECOs, Water conservation measures, lighting, and an energy management system expansion appear to be cost-effective. A professional engineer can best determine the cost, savings and payback for any number or combination of ECOs through a Comprehensive Technical Energy Analysis (CTEA).

Assistance in hiring a qualified engineering firm to conduct a CTEA and in locating funding for the implementation of ECOs is available under Rebuild Michigan Energy Services. There are 59 consulting firms that have been pre-qualified to perform Technical Energy Analyses under Rebuild Michigan Energy Services. *There is a cost for this phase of the program,* and the cost can vary depending on the consulting firm. You may want to request bids from 3-5 firms on the list.

The Michigan Energy Office offers two financial assistance options for the TEA step: an incentive that will cover up to 50% of the TEA cost and an interest-free 18-month loan to cover the remaining cost of your TEA.

The State of Michigan's Energy Office will review the engineering study before it is finalized, provide feedback, and monitor the utility bills for one year after the ECOs are installed to account for the actual energy savings achieved. Troubleshooting will also be provided if savings are lower than expected. In addition, the Energy Office can assist you in pursuing national recognition for energy efficiency in your buildings through the Energy Star Program.

<u>NOTE</u>: *Appendix B contains a complete list of the consulting firms that have been pre-qualified to participate in Rebuild MichiganEnergy Services. Only consulting firms from the list can be hired to perform Technical Energy Analyses under this program.*

Energy Use Analysis

The total cost of energy over the past year at Bedford Falls Public Schools included in this report was $595,590. Electricity accounted for 58% of the total cost at $344,156. Natural gas was responsible for the remaining 42% of the total at $251,434.

Using monthly utility bills for the past year, the Energy Use Index (EUI) in Btu per square foot per year (Btu/sq.ft./year) was calculated for each building. Figure 1 on the next page graphs the EUI for each building compared to the average EUI for similar school buildings in Michigan. Energy use in Btu/sq.ft./year for each building is shown as the combined natural gas (yellow bar) and electricity energy use (blue bar).

As shown in Figure 1, nearly all of the listed Bedford Falls Public School Buildings have higher EUI's than the average for Michigan school buildings. A high EUI in these buildings could be the result of building envelope infiltration, over ventilation, over heating/cooling areas, as well as inefficient lighting.

Figure 2 is a graph of the total energy cost per square foot per year ($/sq.ft./year), or Energy Cost Index (ECI), for each building compared to the average ECI for similar school buildings in Michigan. Each of the buildings included in this report except Third Elementary are also above the Michigan average ECI for similar buildings.

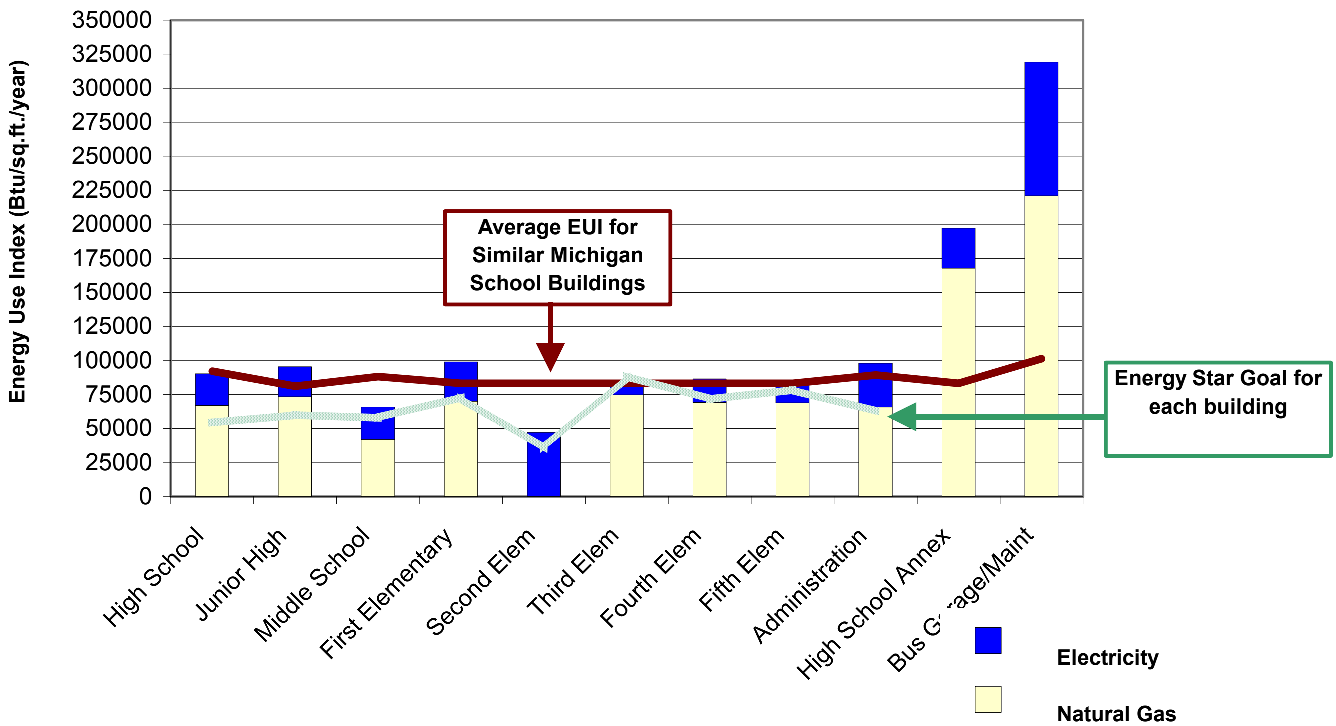
Energy Cost Savings Potential

Using the information in figure 2, it could be concluded that if High School, Junior High, Middle School, First, Second, Fourth, Fifth and the Administrations' energy usage were reduced to the Michigan average, annual savings of more than $84,000 would be possible. If the majority of the ECM's from this report were implemented, it is likely that all buildings will consume less than the average for Michigan buildings, making the annual savings potential even higher.

From information obtained during the walk-through, it is estimated that there is potential for lowering both energy use and cost per square foot in all of the buildings. Water conservation measures, lighting, and an energy management system expansion appear to offer the most cost-effective energy saving opportunities, but many of the low-cost ECOs listed could also provide good savings.

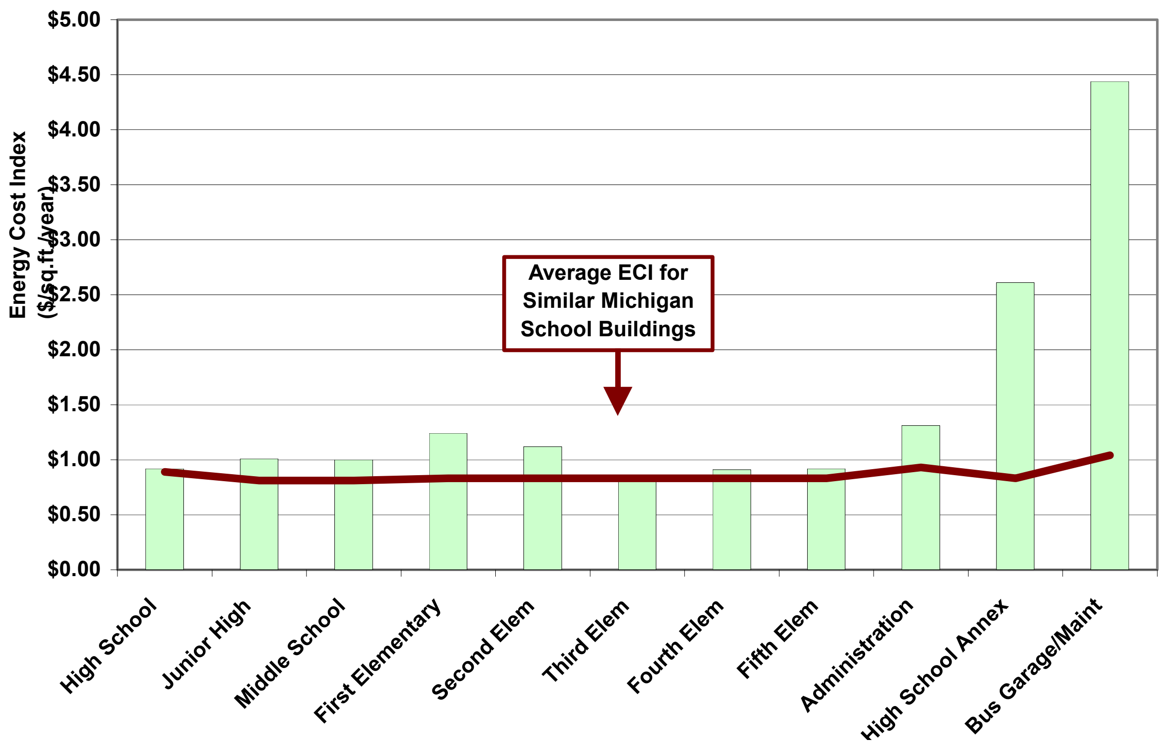
NOTE: Appendix A contains individual energy consumption profiles for each building.

Figure 1 - Energy Use Index (EUI) Benchmark



Name of Building	Natural Gas Use (Btu / sq.ft. / year)	Electricity Use (Btu / sq.ft. / year)	Total EUI (Btu / sq.ft. / year)	Average EUI for Similar Building	Energy Star Goal
High School	67,092	23,130	**90,222**	**92,149**	**54,300**
Junior High	73,233	22,100	**95,333**	**81,035**	**60,000**
Middle School	42,030	23,740	**65,770**	**88,090**	**57,800**
First Elementary	69,937	28,935	**98,872**	**83,127**	**73,000**
Second Elem	0	47,314	**47,314**	**83,127**	**35,100**
Third Elem	74,742	10,187	**84,929**	**83,127**	**88,600**
Fourth Elem	68,997	17,493	**86,490**	**83,127**	**71,500**
Fifth Elem	68,772	15,486	**84,258**	**83,127**	**78,500**
Administration	65,927	32,131	**98,058**	**89,323**	**62,500**
High School Annex	167,914	29,218	**197,132**	**83,127**	
Bus Garage/Maint	220,961	98,305	**319,266**	**101,227**	

Figure 2 - Energy Cost Index (ECI) Benchmark



Name of Building	Natural Gas Cost ($ / sq.ft. / year)	Electricity Cost ($ / sq.ft. / year)	Total ECI ($ / sq.ft. / year)	Average ECI for Similar Building
High School	$0.46	$0.46	**$0.92**	**$0.89**
Junior High	$0.47	$0.54	**$1.01**	**$0.81**
Middle School	$0.33	$0.67	**$1.00**	**$0.81**
First Elementary	$0.49	$0.75	**$1.24**	**$0.83**
Second Elem	$0.00	$1.12	**$1.12**	**$0.83**
Third Elem	$0.53	$0.29	**$0.82**	**$0.83**
Fourth Elem	$0.48	$0.43	**$0.91**	**$0.83**
Fifth Elem	$0.48	$0.44	**$0.92**	**$0.83**
Administration	$0.46	$0.85	**$1.31**	**$0.93**
High School Annex	$1.75	$0.86	**$2.61**	**$0.83**
Bus Garage/Maint	$1.69	$2.75	**$4.44**	**$1.04**

Summary of Energy Conservation Opportunities

Energy Conservation Opportunity (ECO)	Applicable Building	ECO Additional Benefits
1) LED Exit Sign Lighting Complete replacement of exit signs with LED units. LED retrofit lamps can be used in some fixtures, while others may need to be replaced with LED fixtures. 75%-95% savings are possible for exit sign lighting.	All Buildings	Reduce maintenance… LED exit signs and retrofit lamps have 25-year life cycles.
2) Occupancy Sensors Use occupancy sensors to control lighting and exhaust fans. Rooms with irregular use, restrooms, storage areas and offices usually are the best possibilities.	All Buildings	
3) High Ceiling Gym Lighting Replace incandescent and metal halide gymnasium lighting with T-5 High Output fixtures for better lighting and 20-40% savings.	Middle School Second Elem. Junior High High School	Increased Lighting Levels and reduced maintenance
4) T8 Fluorescent Lighting (with electronic ballasts) Replace/retrofit standard T12 fluorescent light fixtures with T8 fluorescent fixtures. A minimum savings of 30% on lighting can be achieved.	Admin High School Junior High Bus Garage	Improve visual acuity; often can *increase* lighting levels; improve student performance
5) Compact Fluorescent Lamps (CFLs) Replace incandescent light bulbs with compact fluorescent lamps.	All Buildings	Reduce maintenance… CFLs outlast 4-12 incandescent lamps (depending on lamp).
6) Daylighting Use natural light to illuminate rooms while turning off electric light fixtures.	Middle School Junior High High School	Less internal heat gain generated resulting in less cooling energy usage
7) Weather Stripping, Caulking and sealing the building envelope Gaps around doors and Windows can lead to a significant amount of heat lost. Sealing cracks in exterior walls can also reduce heat loss	Bus Garage	Improved comfort
8) Timer for Water Heating Circulator Pump Install timer on circulator pump to shut off domestic water heating loop during unoccupied building hours.	High School, Junior High, Middle School First, Second, Third, Fourth, Fifth	Reduce pump motor maintenance.
9) Water Conservation Install low flow kits in toilet and urinal flush valves to save 20-50%. Replace faucet aerators with low flow 1.0-gpm aerators to save at least 50%.	High School, Junior High, HS Annex, Third, Fourth, Fifth, Admin, Bus Garage	Water heating system size can be reduced; shower quality often improved.
10) Adjust Cooling Temperature Consider a review of current cooling temperatures in comparison to recommended levels. Substantial energy savings *may* be achieved (for *FREE*) by adjusting thermostats in all buildings.	First Middle School Admin Fifth	

Energy Conservation Opportunity (ECO)	Applicable Building	ECO Additional Benefits
11) Energy Management System Install an energy management system (EMS) with day-night heating temperature control to allow overnight setback and control heating/cooling system operation.	Second Fourth HS Annex	Improve comfort, control, air quality and ventilation; extend equipment life.
12) Cogged V-Belts Replace standard v-belts with cogged v-belts for HVAC air handlers and air compressors.	Administration	
13) Infrared Radiant Heaters Replace natural gas-fired unit heaters with more efficient infrared radiant heaters.	Bus Garage	
14) Drinking Fountain Timers Control plug-in drinking fountain operation with a 24-hour plug-in timer.	All Buildings	Extend equipment life.
15) Upgrade Pop Machines Disconnect lamps and ballasts inside pop machine, or consider installing power controllers activated by occupancy sensors. Investigate new styles of vending machines that have these features built in.	All Buildings	Reduce pop machine cooling load; extend equipment life.
16) Enable Computer Power-Down Feature Check your computers to make sure the power-down feature is activated.	All Buildings	Extend equipment life.
***) ENERGY STAR Appliances, Computers, Office Equip.** Be sure to specify new appliances, computers and office equipment with U.S. EPA ENERGY STAR rating.	All Buildings	
***) Premium Efficiency Motors** When replacing pump, air handler fan or other motors, be sure to specify premium efficiency motors… any additional cost will be recovered in energy savings.	All Buildings	Improve power quality.

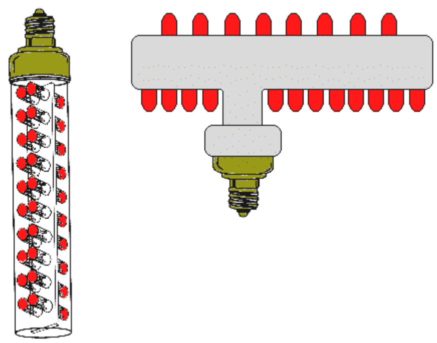
ECO for future consideration when replacement is necessary.

Discussion of Energy Conservation Opportunities

The individual ECOs from the Summary of Energy Conservation Opportunities are discussed below. The energy savings for most ECOs will likely pay for the implementation cost in less than six years… sometimes much less. ECOs involving major building improvements (windows, doors, wall insulation, etc.), sophisticated energy management systems or HVAC system replacements will require an engineering study to determine cost-effectiveness.

ECO # 1: LED Exit Sign Lighting

The development of light emitting diodes (LEDs) has allowed the replacement of exit sign lighting with a more energy efficient alternative. Multiple LEDs, properly configured, produce equivalent lighting and consume 95% less electricity than incandescent bulbs and 75% less than energy-efficient compact fluorescent lamps. A major benefit is the 25-year life cycle rating of LEDs… they virtually *eliminate* exit sign maintenance.



Some lamps can be replaced with LED retrofit lamps that draw only 1-2 watts each. These are screw-in conversions, so installation is quick and easy… rewiring is not necessary. If converting an existing exit sign is not possible, it may be cost-effective to replace it completely with a new LED exit sign fixture.

Consider replacing any remaining incandescent and compact fluorescent fixtures with LED fixtures for immediate energy and maintenance savings.

ECO # 2: Occupancy Sensors

Motion and temperature can be used to indicate occupancy. When there are no occupants in the area being monitored, the lights will be turned off by the sensors.

Passive infrared sensors react to changes in heat, such as the pattern created by a moving person. The control must have an unobstructed view of the building area being scanned... doors, partitions, stairways, etc. will block motion detection and reduce its effectiveness. The best applications for passive infrared occupancy sensors are open spaces with a clear view of the area being monitored.

Passive Infrared Occupancy Sensor (replaces wall switch)

Ultrasonic sensors transmit sound above the range of human hearing and monitor the time it takes for the sound waves to return. A break in the pattern caused by any motion in the area triggers the control. Ultrasonic sensors can see around obstructions and are best for areas with cabinets and shelving, restrooms and open areas requiring 360-degree coverage.

BUILDING AREA	SAVINGS
Offices	25 to 50%
Classrooms	20 to 25%
Rest Rooms	30 to 75%
Storage Areas	45 to 65%

Some occupancy sensors utilize *both* passive infrared and ultrasonic technology, but are usually more expensive. They can be used to control one lamp, one fixture or many fixtures. The table on the left provides typical savings achievable for specific building areas, as determined by EPA studies, with the average savings being 60%.

At all buildings, consider the use of occupancy sensors to control bathroom lighting and exhaust fans. Bathroom exhaust fans are often times overlooked and run round-the-clock, causing higher heating loads and greater electrical usage. Other rooms with irregular use like storage areas, certain offices or classrooms are good possibilities, too. You may have to experiment with several types of sensors at several different room locations to find the best fit for your situation. A qualified lighting engineer can help determine the best occupancy sensor solution for your buildings.

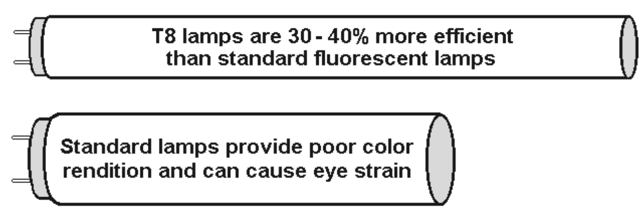
ECO # 3: High Ceiling Gym Lighting

New lighting technologies are constantly emerging and proving themselves effective. The newest trend in lighting applications is replacing HID and Incandescent lighting in high ceiling areas with new T-5 high output fluorescent lamps. T-5 refers to a tubular fluorescent lamp that is five-eighths of an inch in diameter. This measure applies to libraries, atriums, gymnasiums, cafeterias, warehouse spaces, and high bay workshops. In addition to the lighting energy savings (as high as 50% vs. metal halide), T-5 fluorescent lighting is "instant on" and can be controlled with occupancy sensors and dimming controls to produce even more savings. All of this can be accomplished while maintaining recommended light levels and increasing the quality of light.

In the Middle School, Junior High, High School and Second Elementary consider installing T-5 HO lighting in gyms and Cafeterias instead of metal halide or Incandescent fixtures. More information on this technology has been included in your packet.

ECO # 4: T8 Fluorescent Lighting (with electronic ballasts)

The new T8 fluorescent lamps, powered by electronic ballasts, use *30-40% less* energy than standard T12 fluorescent lamps. T8 lamps are available in common lengths, but 4-foot T8s are most popular. Fixtures with 8-foot lamps can often be retrofitted with 4-foot lamps (end to end)… they're more stable, less expensive and have a 33% longer life than the 8-foot lamps.



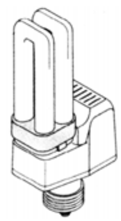
In most cases, older fixtures are replaced with new high efficiency fixtures pre-wired with T8 lamps and electronic ballasts. However, when existing fixtures are in good condition, it is possible to replace just the ballast(s) and lamps.

Besides energy efficiency, T8 fluorescent lighting provides higher quality illumination. Color rendition is better and there is no detectable *flicker* (often exhibited by standard fluorescent fixtures). As a result, visual acuity is improved. There are even studies showing increased student performance under T8 lighting.

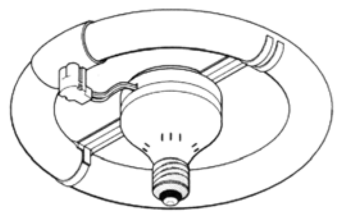
Consider replacement of T12 fluorescent lighting with T8 fluorescent lighting in the Administration, High School, Junior High and the Bus Garage. The sooner this project is completed the sooner the savings will be realized.

ECO # 5: Compact Fluorescent Lamps (CFLs)

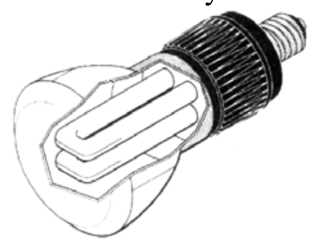
The compact fluorescent lamp (CFL) is an energy efficient alternative to incandescent lighting. CFLs provide equivalent lighting, consume 75-80% *less* energy and last 5 to 15 times *longer* than incandescent lamps. At one time, the application of a CFL was somewhat limited… mainly the replacement of a 60-watt light bulb on a non-dimming circuit. Now there are many types of CFLs available for a wider variety of purposes. Improvements in ballast technology have enabled CFL use outdoors in cold weather and with dimmers, too (but only as specified). They're also available in smaller sizes, and several shapes have been developed to provide more versatility. CFL design is *modular* or *integral*. Sometimes called a *2-piece* CFL, the modular design has a separate lamp and screw-in ballast base. Only the lamp is replaced on burnout… the screw-in ballast base has a longer life and will usually last through five (or more) lamp changes.



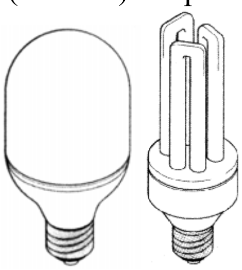
Modular CFL



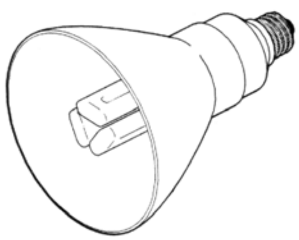
Modular Circline CFL



Modular CFL R-Lamp



Integral CFLs



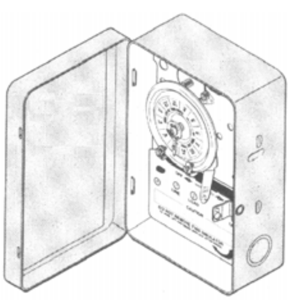
Integral CFL R-Lamp

An integral CFL is a one-piece *throwaway* unit... the entire unit is replaced when it burns out. Since there is very little up-front cost difference between an integral and modular CFL, the modular design is more cost-effective because an individual lamp runs *50-90% less* than the cost to replace an entire CFL unit.

Replace the few incandescent light bulbs that remain with compact fluorescent bulbs. This will provide immediate reduced maintenance and energy savings.

ECO # 6: Timer for Water Heating Circulator Pump

Circulator pumps regularly operate twenty-four hours a day and the domestic water heating system has to cycle more frequently to maintain temperature. Shutting down circulator pumps overnight or whenever the building is unoccupied (for at least 6 hours) is recommended. Electricity savings are gained by shutting down the pump, but over 50% of the *total* savings are directly due to reduced water heater cycling.



Electro-mechanical Timer

Electro-mechanical timers are the typical choice for controlling hot water circulator pumps. They do, however, need to be hard-wired into the circuit. If the pump plugs directly into a wall outlet, a lower cost option is a 24-hour plug-in timer. Either way, the savings will usually justify the cost.

All buildings except for the Administration and the Middle School would be good candidates for this measure.

ECO # 7: Daylighting

Systems are available which control lighting to operate only when natural daylight entering windows is not sufficient to meet interior lighting requirements. Lights can be dimmed or turned off saving energy and operating costs. Horizontal daylight levels range from 10,000 foot-candles on clear summer days down to 1,000 foot-candles on heavily overcast winter days. To put this into perspective, consider that the Illuminating Engineering Society Handbook requires only 20 foot-candles or less for corridors.

Daylighting control choices include: manual on/off, scheduled on/off or dimming, stepped dimming, and continuous dimming. In most applications, automatic lighting controls provide the only reliable means to capture potential savings. Continuous dimming controls provide the highest savings and most readily accepted since light levels are adjusted gradually. Stepped reduction in light intensity is less expensive but is more noticeable to occupants. The system controller senses space illumination level and then dims or increases electric lighting as needed. Manual override switches can be provided. Continuous dimming systems can control both magnetic and electronic ballasts. The potential energy savings is larger with electronic ballasts since they allow lights to be dimmed to 20% capacity versus 50% for magnetic ballasts. Daylighting systems can cut lighting energy costs by 50% or more. Also, during warm outdoor air temperatures, dimming systems reduce building cooling demand by reducing excessive lighting heat rejection to space. A detailed engineering analysis would be required to determine if daylighting controls can provide lighting energy savings at the Middle School, Junior High and the High School.

ECO # 8: Weather Stripping, Caulking and Sealing of the Building Envelope

Infiltration is the flow of air through openings in a building. In order to reduce infiltration, the cracks and holes in a building must be adequately sealed. Infiltration can also occur through cracks in the wall or gaps in the brick and block construction. Maintaining caulking, weather stripping and the building envelope in good condition saves both money and energy. It also preserves the building and improves the comfort of its occupants.

ECO # 9: Water Conservation

Low Flush Toilets (1.6-gallons per flush)

Low flush toilets use only 1.6-gallons per flush (gpf) compared to the 3.5-gpf and 5.0-gpf models of recent history. These new units can often reduce water consumption by 50-75% over the old fixtures. It is important to note that *some* of the older models from the mid-1980s were poorly designed and produced poor results, but the new 1.6-gpf toilets have gained wide acceptance.

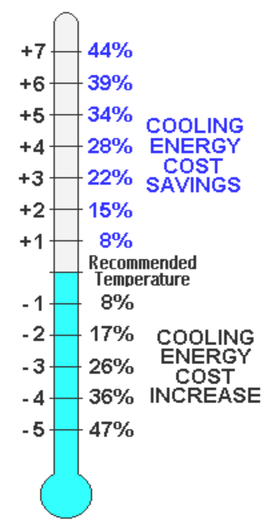
There are three types of low flush toilets: gravity, pressure-assisted and vacuum-assisted, and the cost increases in the same order. For most applications, gravity flush toilets perform very well. All three types require proper maintenance; *some* of the gravity flush toilets and *all* of the pressure-assisted and vacuum-assisted units require specialized parts that may be expensive and/or difficult to find. Using the wrong replacement parts can greatly increase flushing volume.

Low Flow Faucet Moderators (1.0-gallon per minute)

Low flow faucet moderators can reduce water use through faucets substantially for water/sewer cost savings. In the case of hot water, energy savings can be achieved too. Good moderators maintain adequate pressure and the effect of a full stream of water while reducing the flow rate (a 50-75% reduction is possible). Consider this measure at the Administration, High School, Junior High, High School Annex, Third, Bus Garage, Fifth and Fourth.

ECO # 10: Adjust Cooling Temperature

Temperature requirements for school buildings vary with occupancy schedules and the type of activities being conducted. For example, the recommended cooling temperature for classrooms and offices is 76°F when the building is occupied. Higher settings are often possible in corridors, storage areas, restrooms and gymnasiums, while lower settings are usually necessary for computer rooms. When air conditioning a school building, you should try to keep the cooling temperature at the highest possible setting while still maintaining comfort. As the graphic on the right illustrates, the savings can be quite significant for this measure. For example, it can cost up to *36% more* to cool offices and classrooms to 72°F rather than 76°F.



BUILDING AREA	Recommended Temperature °F
Classrooms, Offices	76 ° F
Cafeterias, Auditoriums	76 ° F
Computer Rooms	74 ° F
Restrooms	78 ° F
Gymnasiums	78 ° F
Corridors	80 ° F
Storage Rooms	82 ° F

Recommended cooling temperatures for various building areas during occupied hours are shown on the left. (Ideally, the air conditioning should be shut off when the building is unoccupied, but studies have shown that over half of the savings available are achieved with just a 5-degree increase… even minor temperature increases during unoccupied hours can produce a good savings).

You may want to consider reviewing current cooling temperatures in comparison to recommended levels in First Elementary, Second Elementary and Fourth Elementary.

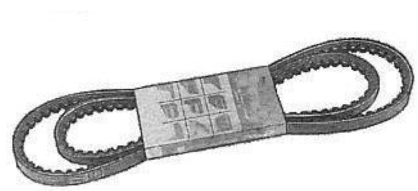
ECO # 11: Energy Management System (EMS)

Controlling energy usage in school buildings can be a difficult undertaking, depending on the type of activity that is being conducted at the facility. Normally, there are several energy systems operating at the same time such as lighting, space heating/cooling and water heating. Attempting to control these systems manually is generally difficult, inefficient and costly. If the systems are complex, energy efficient control is often beyond the capabilities of clock thermostats, timers and other simple programmable devices. An energy management system (EMS) could be the best option for energy efficient and cost effective operation under these circumstances.

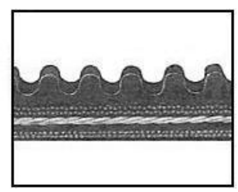
There is a wide variety of EMS equipment on the market. Basic models are available that control building temperatures and the heating, ventilation and air conditioning (HVAC) system. More advanced EMS units can control and monitor building operations (such as HVAC, fire alarms, lighting etc.) and provide computer printouts of almost unlimited options regarding energy use by each system. A *central* EMS can do this for multiple buildings… energy use can be monitored and controlled for all buildings from a central location.

Currently nearly all buildings in this district operate on an EMS. The High School Annex, Second and Fourth could all be added to the current EMS system to reduce the energy use in these buildings.

ECO # 12: Cogged V-Belts



COGGED V-BELT



Motors and belts are commonly utilized for heating, ventilating and air-conditioning (HVAC) systems and air compressors. One of the natural inefficiencies in these systems is the *slip* that occurs between a standard v-belt and the sheaves on which it is mounted. This reduces power transmission from the motor to the equipment being driven. Studies show that replacing standard v-belts with cogged v-belts can reduce slip and improve system efficiency by as much as 8%.
Cogged v-belts cost a little more than standard v-belts but they also have longer life cycles, which more than offsets the extra cost. The energy savings produced by improved system efficiency often pay for the cost of installing cogged v-belts in a matter of months.

At the Administration Building, you should consider replacement of standard v-belts with cogged v-belts on HVAC system air handlers.

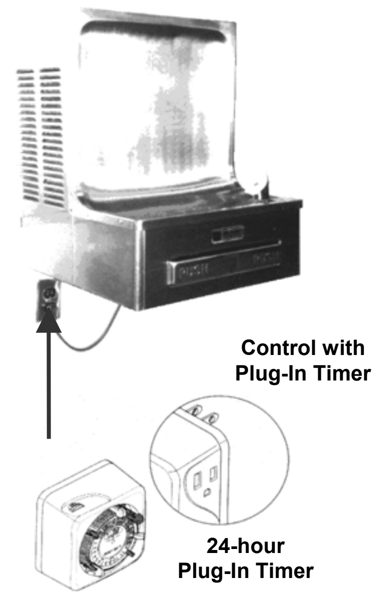
ECO # 13: Infrared Radiant Heaters

Natural gas-fired unit heaters used in tall spaces at the Service Center and the fire/DPS building are poor comfort heaters. Air is discharged from suspended unit heaters at temperatures well over 100ºF. This less dense buoyant air rises to top of room resulting in heat stratification leaving occupied floor zone cool. The warm air at ceiling creates large temperature gradient between inside and outside building surfaces increasing heat loss through ceiling/roof construction. When overhead doors open, heated air escapes; when doors close, a long time is required to reheat space air to acceptable comfort level.

Natural gas-fired infrared heaters function well in spaces with doors open to the outdoors since the radiant energy heats objects and not air. Tools, equipment, and vehicles are kept warm at operating temperatures. Truck maintenance costs can be reduced since truck bottoms dry faster reducing rust and corrosion. The objects re-radiate their warmth to adjacent objects. Two stage burners, condensing heat exchangers, and temperature setback strategies further reduce energy use. Natural gas savings will be approximately 30% where infrared heaters replace unit heaters. Infrared heaters are recommended at the Bus Garage high bay areas.

ECO # 14: Drinking Fountain Timer

Drinking fountains are often refrigerated types that keep chilled water available on a continuous basis. Much of the time, these units can be modified to save energy consumed by the compressor to refrigerate the water. Overnight or during periods the building is unoccupied, the drinking fountain can be turned off (chilling of water during winter months is often unnecessary, too). Because a drinking fountain can cost as much to operate as a small refrigerator over the course of one year, the savings potential for turning it off when possible makes this measure worth consideration, especially if your facility has several units.



Short of shutting off power to the drinking fountain permanently, the best option is to install a timer to control hours of operation to coincide with building hours. An inexpensive 24-hour *plug-in timer* can be installed if a drinking fountain is the plug-in type. (For wired drinking fountains, individual timers have to be wired into each unit… usually, the savings *will not* justify the cost).

ECO # 15: Upgrade Pop Machines

Refrigerated pop machines operate 24 hours/day, often with display lighting operating continuously. The lighting produces heat, which adds to the load on the compressor, increasing refrigeration cost. Disconnecting the ballast and lamps can save up to $100 per year!

During periods the building is unoccupied, a pop machine can be turned off. With an operating cost greater than that of a large refrigerator, the savings potential for turning it off whenever possible is significant. There is now a power controller available that is activated by an occupancy sensor that will shut the machine down when the area is unoccupied (primarily overnight). This device will not shut the machine down while the compressor is cycling (which can be harmful) and is approved by several of the major soft drink companies. The payback for power controllers is generally in the 1-2 year range.

NOTE: Consult vendor before implementing this measure.

ECO # 16: Enable Computer Power-Down Feature

The majority of computers manufactured in the past five years have power-down capability, which usually needs to be activated. All computers purchased in the last five years should be checked for this feature and activated, if necessary. When purchasing computer equipment, the U.S. EPA Energy Star standards should be specified. Upon delivery of the equipment, the power-down feature should be activated.

Software titled "EZ Save" is now available, which allows administrators to enable power management strategies and change computer and monitor settings from central servers. There is also software available titled "EZ WIZARD" which can be used for decentralized stations, which are web based. Software is free and can be downloaded from http://www.energystar.gov/powermanagement.

ECO (Future): ENERGY STAR Appliances, Computers & Office Equipment

Energy costs associated with electrical plug loads should be minimized where possible. Plug loads are electrical devices plugged into the building's electrical system and generally include things like appliances, computers, printers and office equipment such as fax machines and copiers. When purchasing appliances, computers and office equipment, the U.S. EPA ENERGY STAR standards should be specified. Manufacturers are required to meet certain energy efficiency criteria before they can label a product with the ENERGY STAR emblem, so these products represent your best energy saving value. To view Energy Star requirements and products visit the Energy Star website at: `www.energystar.gov`.

ECO (Future): Premium Efficiency Motors

Using better quality steel, larger conductors with lower electrical resistance, improved bearings and low-loss fan designs, the new premium efficiency motors can save up to 10% over standard models. If existing motors are old or poorly maintained (or both), the savings can be greater.

Motors need to be properly sized for maximum efficiency. When considering replacement, it is important to make sure that the new motor is sized correctly for the job. A motor that is too large for the task at hand will be inefficient and more costly to operate.

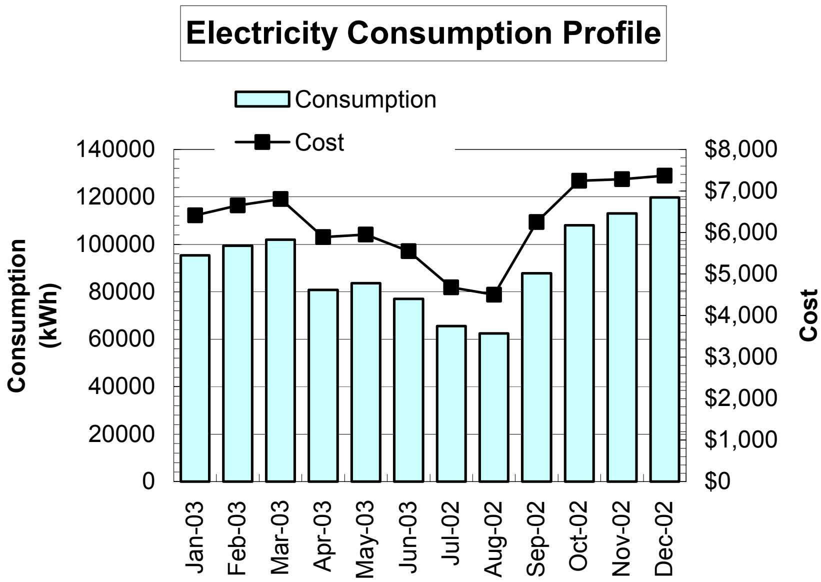
Finally, premium efficiency motors have higher power factors. This is especially important when trying to prevent penalty charges (due to low power factor) from being assessed on your electric bill. Correcting power factor is also an easier task when equipment, like a premium efficiency motor, has a higher rating to begin with.

When replacing pump, air handler fan or other motors, be sure to specify premium efficiency motors. Any additional expense will be recovered quickly in energy savings.

Appendix A: Energy Consumption Profiles

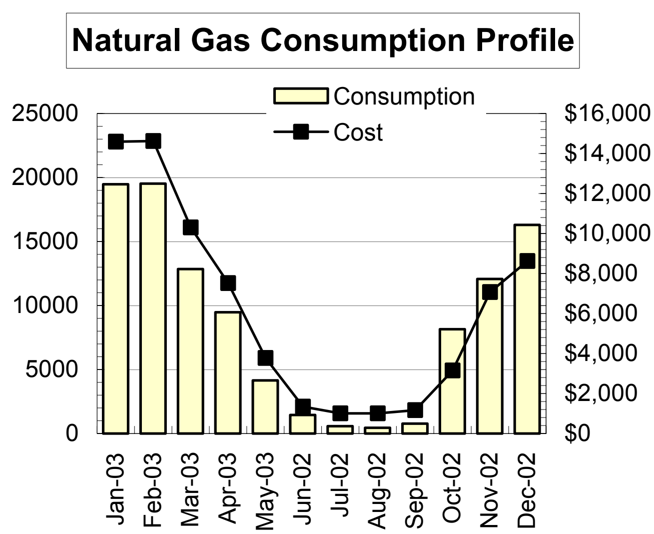
High School

Square Ft	161,544	**Wall Construction**	Brick and Block	**Heating**	(2) 2003 HW Boilers
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	(5) DX rooftop units
Additions		**Windows**	Dbl pane wood and Alu	**Distribution**	Radient and Forced Air
DHW	(2) Boilers	**Interior Lighting**	T-8, T-12, MH	**Temp Cont.**	DDC
	w/ 1000+ storage	**Exterior Lighting**	HPS, Timers	**Other**	



Month	kWh	Cost
Jan-03	95,400	$6,413
Feb-03	99,400	$6,655
Mar-03	102,000	$6,804
Apr-03	80,800	$5,891
May-03	83,600	$5,950
Jun-03	77,000	$5,550
Jul-02	65,600	$4,680
Aug-02	62,400	$4,499
Sep-02	87,800	$6,251
Oct-02	108,000	$7,245
Nov-02	113,000	$7,281
Dec-02	119,800	$7,371
Totals:	**1,094,800**	**$74,589**

Cost/sq.ft.: $0.46 per sq.ft./yr.
Elec EUI: 23,130 BTU/sq.ft.
Avg. Cost: $0.068 /kWh



Month	CCF	Cost
Jan-03	19,465	$14,586
Feb-03	19,514	$14,621
Mar-03	12,848	$10,299
Apr-03	9,467	$7,526
May-03	4,148	$3,769
Jun-02	1,440	$1,336
Jul-02	576	$1,002
Aug-02	459	$1,011
Sep-02	781	$1,174
Oct-02	8,153	$3,149
Nov-02	12,073	$7,068
Dec-02	16,302	$8,627
Totals:	**105,226**	**$74,167**

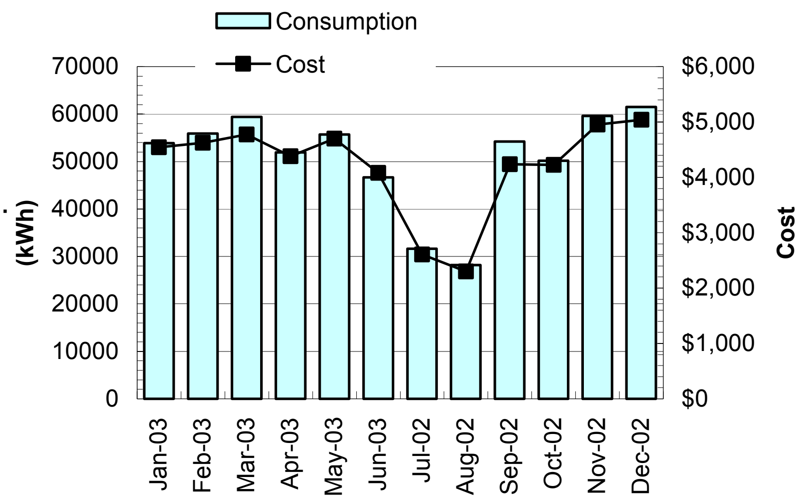
Cost/sq.ft.: $0.46 per sq.ft./yr.
Gas EUI: 67,092 BTU/sq.ft.
Avg. Cost: $0.705 / CCF

Annual Utility Cost = $148,757
Total Cost / sq.ft. = $0.92
Combined EUI = 90,222

Junior High

Square Ft	94,013	**Wall Construction**	Brick and Block	**Heating**	(2) 2002 HW Boilers
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	rooftop DX units
Additions		**Windows**	Dbl pane wood and Alu	**Distribution**	Radient and Forced Air
DHW	1987 HW Boiler	**Interior Lighting**	T-8, T-12, MH	**Temp Cont.**	DDC
		Exterior Lighting	HPS, Timers	**Other**	

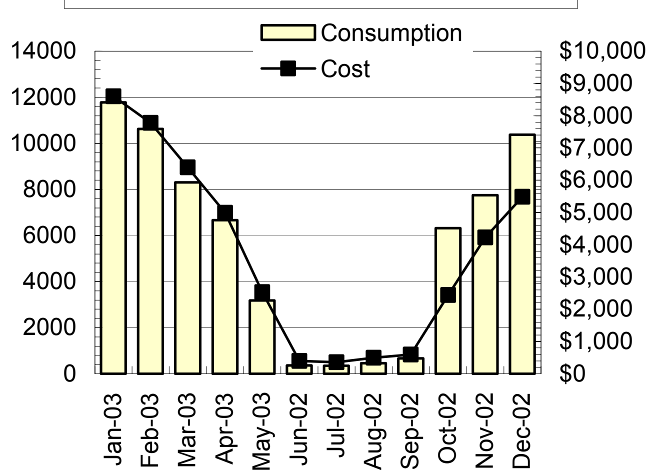
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	53,880	$4,545
Feb-03	55,880	$4,622
Mar-03	59,440	$4,772
Apr-03	51,920	$4,382
May-03	55,680	$4,701
Jun-03	46,680	$4,080
Jul-02	31,600	$2,605
Aug-02	28,200	$2,300
Sep-02	54,200	$4,235
Oct-02	50,160	$4,227
Nov-02	59,600	$4,952
Dec-02	61,520	$5,038
Totals:	**608,760**	**$50,459**

Cost/sq.ft.: $0.54 per sq.ft./yr.
Elec EUI: 22,100 BTU/sq.ft.
Avg. Cost: $0.083 /kWh

Natural Gas Consumption Profile



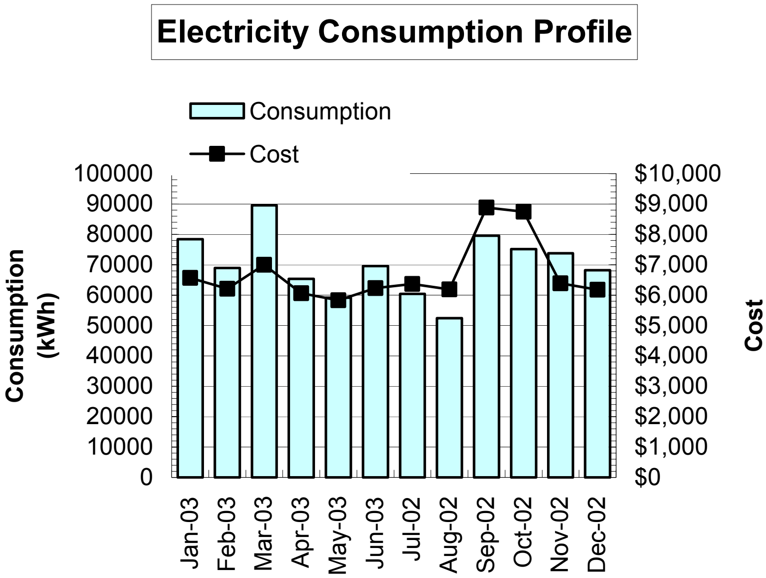
Month	CCF	Cost
Jan-03	11,779	$8,598
Feb-03	10,619	$7,779
Mar-03	8,306	$6,395
Apr-03	6,671	$4,991
May-03	3,186	$2,530
Jun-02	358	$398
Jul-02	351	$360
Aug-02	459	$491
Sep-02	666	$596
Oct-02	6,320	$2,441
Nov-02	7,756	$4,229
Dec-02	10,372	$5,489
Totals:	**66,843**	**$44,297**

Cost/sq.ft.: $0.47 per sq.ft./yr.
Gas EUI: 73,233 BTU/sq.ft.
Avg. Cost: $0.663 / CCF

Annual Utility Cost = $94,756
Total Cost / sq.ft. = $1.01
Combined EUI = 95,333

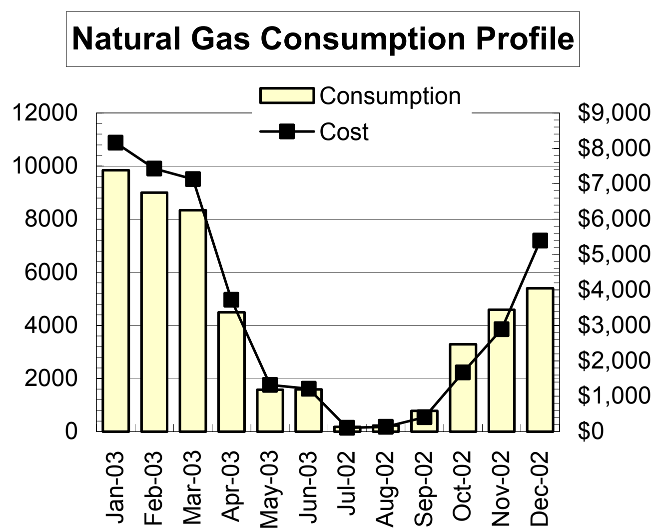
Mackinaw Trail Middle School

Square Ft	120,876	**Wall Construction**	Brick and Block	**Heating**	(2) 1997 HW Boilers
Year Built		**Roof Construction**	Flat black Rubber and F	**Cooling**	Chiller, Glycol/water (3) comp
Additions		**Windows**	Dbl pane	**Distribution**	(7) AHUs w/ reheats in VAV b
DHW	HW boiler	**Interior Lighting**	T-8, MH	**Temp Cont.**	DDC
		Exterior Lighting	HPS, Timers	**Other**	



Month	kWh	Cost
Jan-03	78,400	$6,571
Feb-03	69,000	$6,206
Mar-03	89,600	$7,004
Apr-03	65,400	$6,067
May-03	59,200	$5,827
Jun-03	69,600	$6,230
Jul-02	60,400	$6,370
Aug-02	52,400	$6,193
Sep-02	79,600	$8,883
Oct-02	75,200	$8,749
Nov-02	73,800	$6,393
Dec-02	68,200	$6,176
Totals:	**840,800**	**$80,669**

Cost/sq.ft.: $0.67 per sq.ft./yr.
Elec EUI: 23,740 BTU/sq.ft.
Avg. Cost: $0.096 /kWh



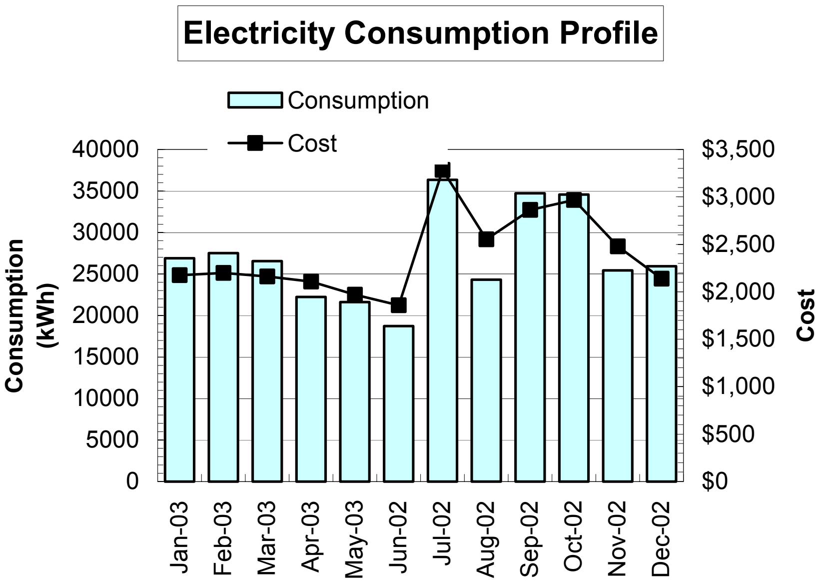
Month	CCF	Cost
Jan-03	9,846	$8,162
Feb-03	9,002	$7,431
Mar-03	8,334	$7,130
Apr-03	4,499	$3,721
May-03	1,583	$1,319
Jun-03	1,587	$1,207
Jul-02	179	$105
Aug-02	234	$133
Sep-02	782	$409
Oct-02	3,286	$1,670
Nov-02	4,595	$2,895
Dec-02	5,398	$5,398
Totals:	**49,325**	**$39,581**

Cost/sq.ft.: $0.33 per sq.ft./yr.
Gas EUI: 42,030 BTU/sq.ft.
Avg. Cost: $0.802 / CCF

Annual Utility Cost = $120,250
Total Cost / sq.ft. = $0.99
Combined EUI = 65,771

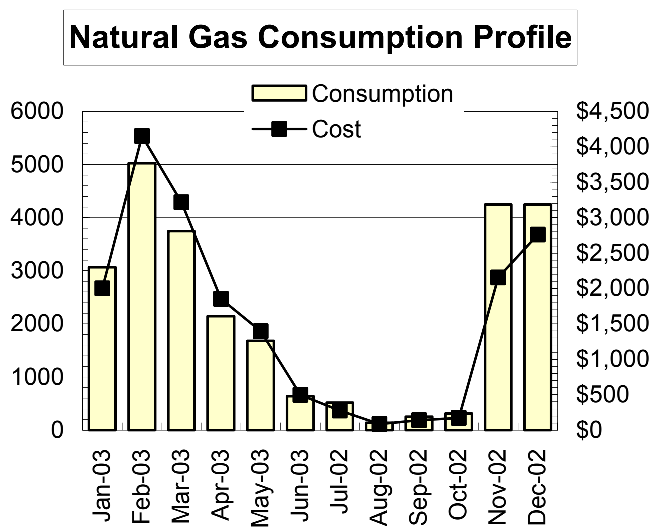
First Elementary

Square Ft	38,312	**Wall Construction**	Brick and Block	**Heating**	(2) 1997 HW Boilers
Year Built		**Roof Construction**	Flat Rubber and Pitche(	**Cooling**	Chiller, Glycol/water (2) comp
Additions		**Windows**	Dbl pane	**Distribution**	Radiant and forced air
DHW	1997 HW Boiler	**Interior Lighting**	T-8, MH	**Temp Cont.**	DDC
		Exterior Lighting	HPS, Timers	**Other**	



Month	kWh	Cost
Jan-03	26,880	$2,175
Feb-03	27,520	$2,200
Mar-03	26,560	$2,162
Apr-03	22,240	$2,107
May-03	21,600	$1,970
Jun-02	18,720	$1,859
Jul-02	36,320	$3,283
Aug-02	24,320	$2,551
Sep-02	34,720	$2,862
Oct-02	34,560	$2,967
Nov-02	25,440	$2,478
Dec-02	25,920	$2,138
Totals:	**324,800**	**$28,751**

Cost/sq.ft.: $0.75 per sq.ft./yr.
Elec EUI: 28,935 BTU/sq.ft.
Avg. Cost: $0.089 /kWh



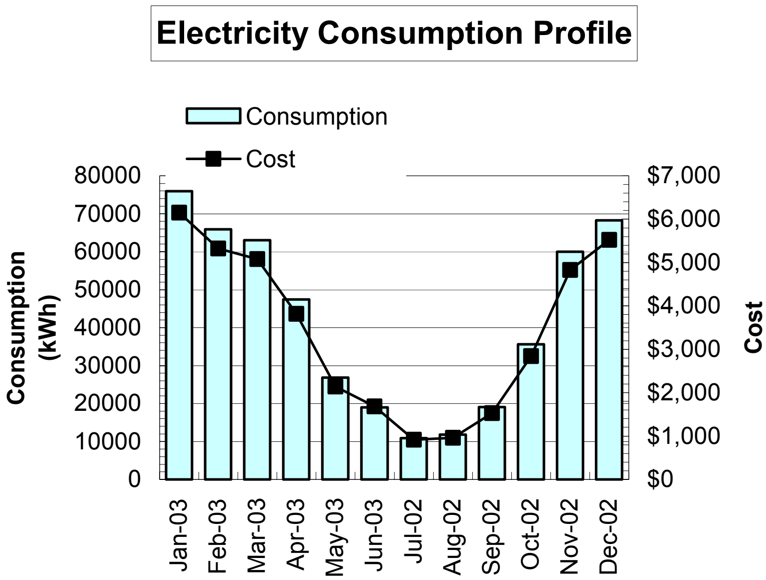
Month	CCF	Cost
Jan-03	3,069	$2,000
Feb-03	5,023	$4,153
Mar-03	3,748	$3,215
Apr-03	2,146	$1,852
May-03	1,679	$1,398
Jun-03	640	$496
Jul-02	519	$276
Aug-02	139	$85
Sep-02	252	$142
Oct-02	311	$172
Nov-02	4,244	$2,153
Dec-02	4,244	$2,760
Totals:	**26,014**	**$18,701**

Cost/sq.ft.: $0.49 per sq.ft./yr.
Gas EUI: 69,937 BTU/sq.ft.
Avg. Cost: $0.719 / CCF

Annual Utility Cost = $47,453
Total Cost / sq.ft. = $1.24
Combined EUI = 98,872

Second Elementary

Square Ft	36,350	**Wall Construction**	Brick and Block	**Heating**	Electric baseboard
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	N/A
Additions		**Windows**	Dbl pane wood and Alu	**Distribution**	rad and fans
DHW	Elec Tanks	**Interior Lighting**	T-8, MH	**Temp Cont.**	manual t-stats
w/ 300+ gallons of storage		**Exterior Lighting**	HPS, Timers	**Other**	



Month	kWh	Cost
Jan-03	75,989	$6,149
Feb-03	65,914	$5,325
Mar-03	63,074	$5,081
Apr-03	47,459	$3,818
May-03	26,859	$2,144
Jun-03	18,947	$1,682
Jul-02	10,891	$916
Aug-02	11,819	$962
Sep-02	19,061	$1,528
Oct-02	35,580	$2,843
Nov-02	60,028	$4,833
Dec-02	68,290	$5,520
Totals:	**503,911**	**$40,799**

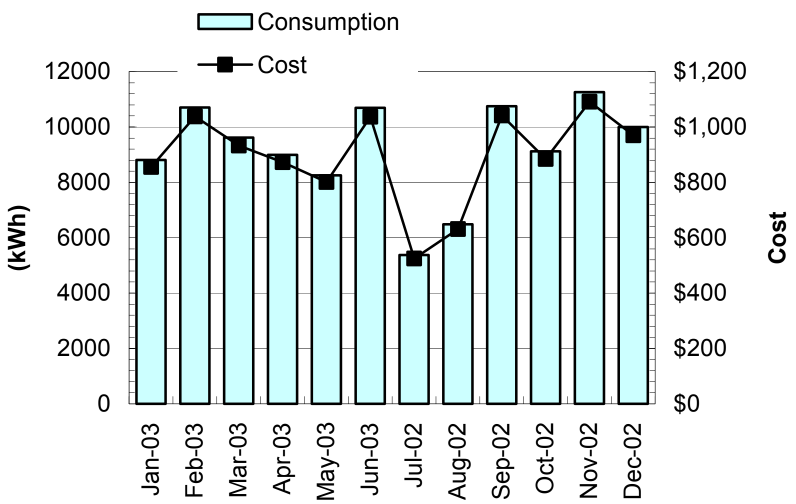
Cost/sq.ft.: $1.12 per sq.ft./yr.
Elec EUI: 47,314 BTU/sq.ft.
Avg. Cost: $0.081 /kWh

Annual Utility Cost = $40,799
Total Cost / sq.ft. = $1.12
Combined EUI = 47,314

Third Elementary

Square Ft	36,876	**Wall Construction**	Brick and Block	**Heating**	(6) 1990 modulated boilers
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	N/A
Additions		**Windows**	single pane Alum	**Distribution**	radiant, unit vents, AHUs
DHW	tank, gas	**Interior Lighting**	T-8, MH	**Temp Cont.**	DDC
		Exterior Lighting	HPS, Timers	**Other**	

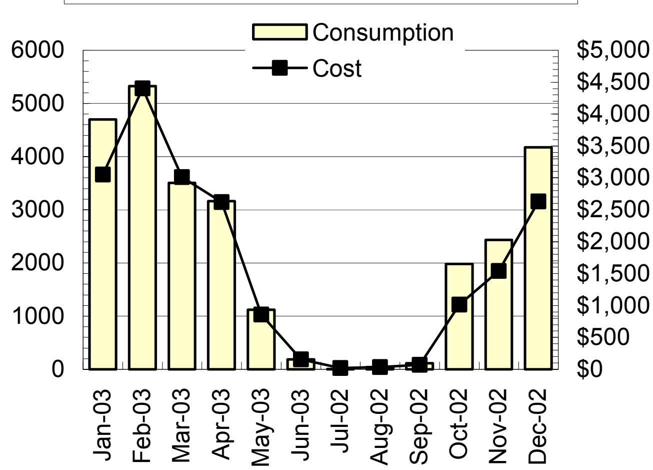
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	8,812	$855
Feb-03	10,708	$1,038
Mar-03	9,614	$933
Apr-03	8,990	$873
May-03	8,252	$801
Jun-03	10,698	$1,037
Jul-02	5,381	$525
Aug-02	6,482	$631
Sep-02	10,751	$1,042
Oct-02	9,116	$885
Nov-02	11,258	$1,091
Dec-02	10,001	$970
Totals:	**110,063**	**$10,680**

Cost/sq.ft.: $0.29 per sq.ft./yr.
Elec EUI: 10,187 BTU/sq.ft.
Avg. Cost: $0.097 /kWh

Natural Gas Consumption Profile



Month	CCF	Cost
Jan-03	4,700	$3,054
Feb-03	5,328	$4,404
Mar-03	3,508	$3,010
Apr-03	3,162	$2,620
May-03	1,123	$858
Jun-03	189	$156
Jul-02	8	$19
Aug-02	41	$36
Sep-02	114	$72
Oct-02	1,979	$1,012
Nov-02	2,433	$1,540
Dec-02	4,174	$2,631
Totals:	**26,759**	**$19,413**

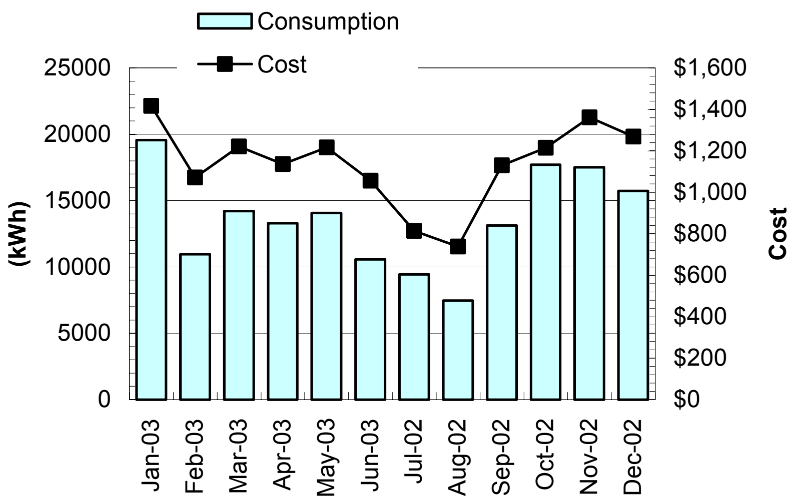
Cost/sq.ft.: $0.53 per sq.ft./yr.
Gas EUI: 74,742 BTU/sq.ft.
Avg. Cost: $0.725 / CCF

Annual Utility Cost = $30,093
Total Cost / sq.ft. = $0.82
Combined EUI = 84,928

Fourth Elementary

Square Ft	31,924	**Wall Construction**	Brick and block	**Heating**	(4) 1999 modulated boilers
Year Built		**Roof Construction**	Flat black Rubber, pitch	**Cooling**	window DX units
Additions		**Windows**	single pane Alum	**Distribution**	radiant
DHW	tank, gas	**Interior Lighting**	T-8, MH	**Temp Cont.**	pneumatic t-stats
		Exterior Lighting	HPS, Timers	**Other**	

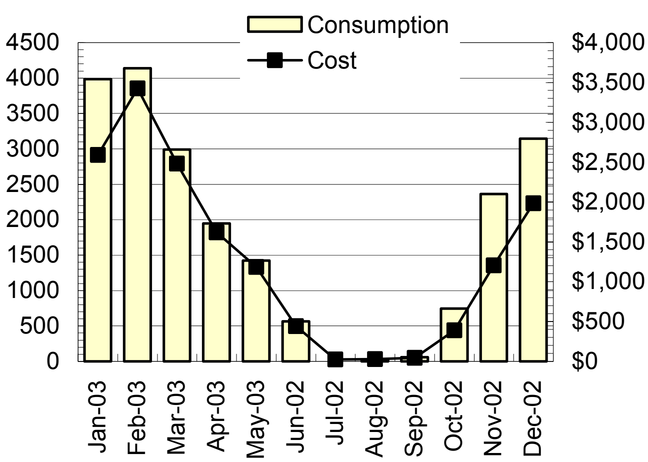
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	19,558	$1,416
Feb-03	10,958	$1,071
Mar-03	14,200	$1,221
Apr-03	13,292	$1,137
May-03	14,071	$1,216
Jun-03	10,574	$1,056
Jul-02	9,439	$814
Aug-02	7,462	$738
Sep-02	13,125	$1,130
Oct-02	17,700	$1,215
Nov-02	17,504	$1,362
Dec-02	15,737	$1,268
Totals:	**163,620**	**$13,643**

Cost/sq.ft.:	$0.43	per sq.ft./yr.
Elec EUI:	**17,493**	**BTU/sq.ft.**
Avg. Cost:	$0.083	/kWh

Natural Gas Consumption Profile



Month	CCF	Cost
Jan-03	3,984	$2,592
Feb-03	4,139	$3,425
Mar-03	2,993	$2,481
Apr-03	1,947	$1,619
May-03	1,422	$1,186
Jun-02	566	$440
Jul-02	0	$24
Aug-02	23	$27
Sep-02	60	$45
Oct-02	747	$391
Nov-02	2,361	$1,204
Dec-02	3,143	$1,985
Totals:	**21,385**	**$15,419**

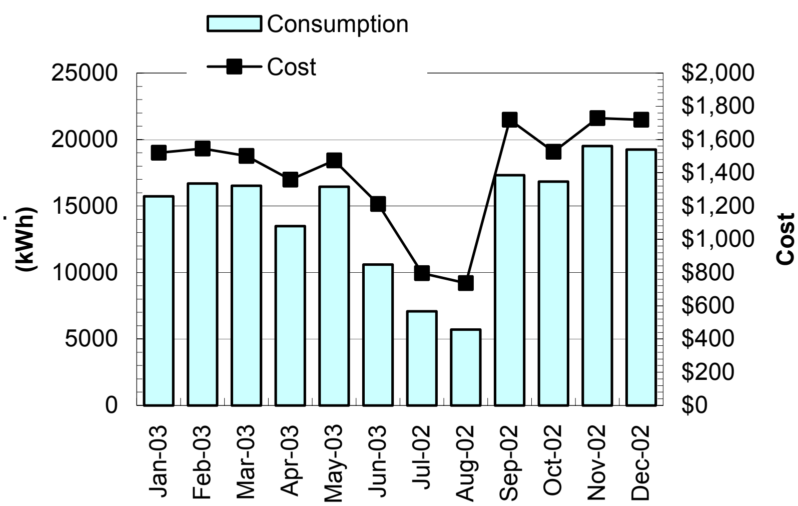
Cost/sq.ft.:	$0.48	per sq.ft./yr.
Gas EUI:	**68,997**	**BTU/sq.ft.**
Avg. Cost:	$0.721	/ CCF

Annual Utility Cost = $29,062
Total Cost / sq.ft. = $0.91
Combined EUI = 86,489

Fifth Elementary

Square Ft	38,605	**Wall Construction**	Brick and block	**Heating**	(4) 2000 modulated boilers
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	(9) Rooftop DX units
Additions		**Windows**	single pane Alum	**Distribution**	unit vents, AHUs
DHW	2) 50 gal tanks, ga	**Interior Lighting**	T-8, MH	**Temp Cont.**	DDC
		Exterior Lighting	HPS, Timers and photo	**Other**	

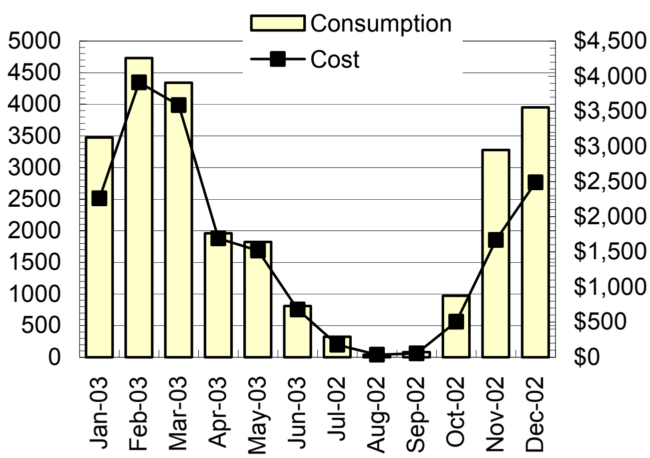
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	15,720	$1,520
Feb-03	16,680	$1,545
Mar-03	16,520	$1,501
Apr-03	13,480	$1,359
May-03	16,440	$1,474
Jun-03	10,600	$1,212
Jul-02	7,080	$796
Aug-02	5,720	$737
Sep-02	17,320	$1,718
Oct-02	16,840	$1,526
Nov-02	19,520	$1,729
Dec-02	19,240	$1,718
Totals:	**175,160**	**$16,835**

Cost/sq.ft.: $0.44 per sq.ft./yr.
Elec EUI: 15,486 BTU/sq.ft.
Avg. Cost: $0.096 /kWh

Natural Gas Consumption Profile



Month	CCF	Cost
Jan-03	3,474	$2,262
Feb-03	4,729	$3,911
Mar-03	4,340	$3,590
Apr-03	1,959	$1,691
May-03	1,823	$1,517
Jun-03	809	$681
Jul-02	322	$177
Aug-02	38	$34
Sep-02	80	$55
Oct-02	973	$505
Nov-02	3,278	$1,666
Dec-02	3,951	$2,491
Totals:	**25,776**	**$18,583**

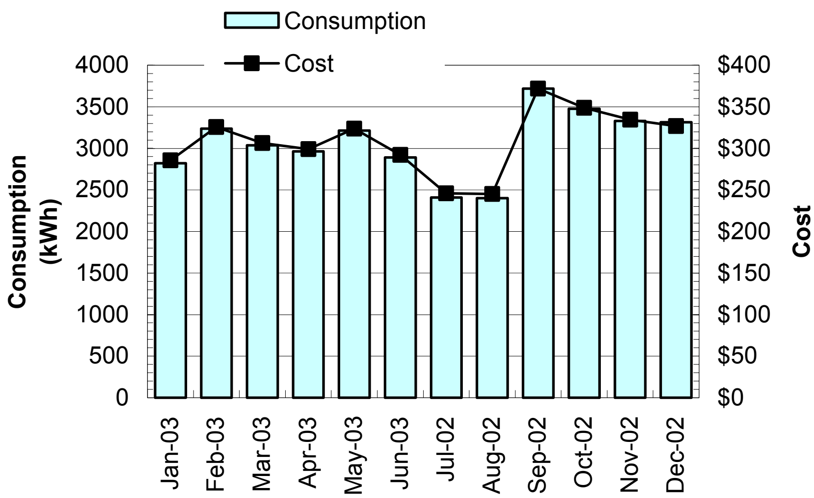
Cost/sq.ft.: $0.48 per sq.ft./yr.
Gas EUI: 68,772 BTU/sq.ft.
Avg. Cost: $0.721 / CCF

Annual Utility Cost = $35,417
Total Cost / sq.ft. = $0.92
Combined EUI = 84,257

High School Annex

Square Ft	4,300	**Wall Construction**	Brick and block	**Heating**	(2) 1997 HW Boilers
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	N/A
Additions		**Windows**	double pane	**Distribution**	Radiant, unit vents
DHW	small tank, gas	**Interior Lighting**	T-8	**Temp Cont.**	pneumatic t-stats
		Exterior Lighting	HPS, Timers	**Other**	

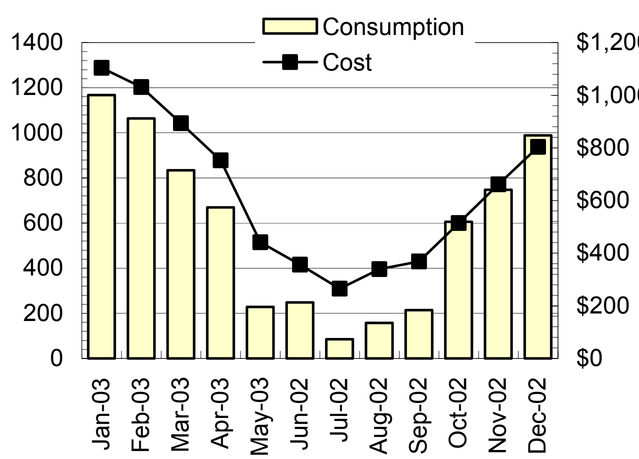
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	2,819	$285
Feb-03	3,236	$326
Mar-03	3,038	$306
Apr-03	2,962	$299
May-03	3,215	$324
Jun-03	2,890	$292
Jul-02	2,410	$246
Aug-02	2,402	$245
Sep-02	3,719	$372
Oct-02	3,476	$349
Nov-02	3,330	$335
Dec-02	3,314	$327
Totals:	**36,811**	**$3,706**

Cost/sq.ft.: $0.86 per sq.ft./yr.
Elec EUI: 29,218 BTU/sq.ft.
Avg. Cost: $0.101 /kWh

Natural Gas Consumption Profile



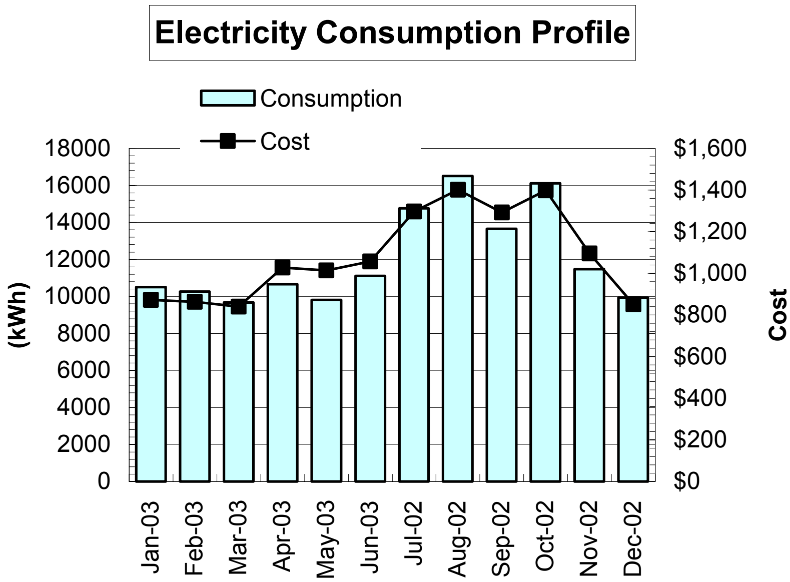
Month	CCF	Cost
Jan-03	1,167	$1,104
Feb-03	1,064	$1,031
Mar-03	834	$894
Apr-03	669	$752
May-03	229	$442
Jun-02	248	$356
Jul-02	85	$265
Aug-02	157	$339
Sep-02	214	$368
Oct-02	606	$514
Nov-02	748	$661
Dec-02	989	$803
Totals:	**7,010**	**$7,530**

Cost/sq.ft.: $1.75 per sq.ft./yr.
Gas EUI: 167,914 BTU/sq.ft.
Avg. Cost: $1.074 / CCF

Annual Utility Cost = $11,236
Total Cost / sq.ft. = $2.61
Combined EUI = 197,132

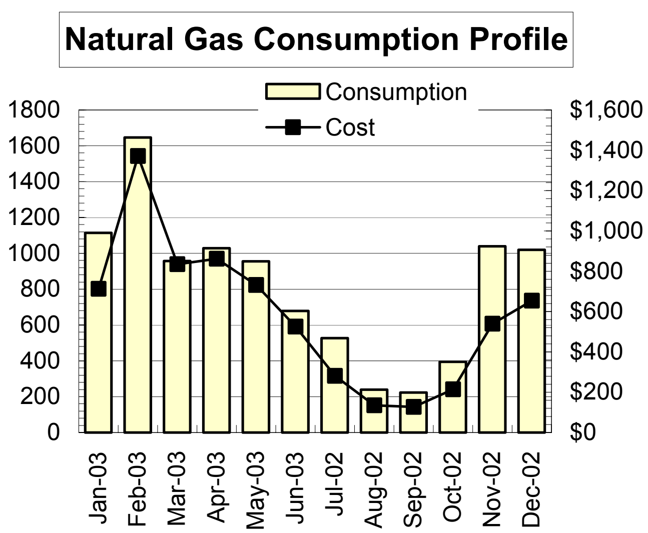
Administration

Square Ft	15,350	**Wall Construction**	Brick and block	**Heating**	1997 HW Boiler
Year Built		**Roof Construction**	Flat black Rubber	**Cooling**	Rooftop DX Units
Additions		**Windows**	double pane	**Distribution**	Forced Air
DHW	tank, gas	**Interior Lighting**	T-8, T-12, MH	**Temp Cont.**	DDC
	no cic. Pump	**Exterior Lighting**	HPS, MV Timers and p	**Other**	



Month	kWh	Cost
Jan-03	10,501	$872
Feb-03	10,268	$863
Mar-03	9,673	$840
Apr-03	10,670	$1,027
May-03	9,820	$1,014
Jun-03	11,110	$1,057
Jul-02	14,772	$1,298
Aug-02	16,512	$1,402
Sep-02	13,663	$1,292
Oct-02	16,120	$1,399
Nov-02	11,469	$1,095
Dec-02	9,931	$850
Totals:	**144,509**	**$13,010**

Cost/sq.ft.:	$0.85	per sq.ft./yr.
Elec EUI:	**32,131**	**BTU/sq.ft.**
Avg. Cost:	$0.090	/kWh



Month	CCF	Cost
Jan-03	1,114	$713
Feb-03	1,647	$1,372
Mar-03	958	$835
Apr-03	1,029	$863
May-03	955	$732
Jun-03	679	$525
Jul-02	527	$280
Aug-02	239	$135
Sep-02	223	$127
Oct-02	395	$214
Nov-02	1,040	$539
Dec-02	1,019	$654
Totals:	**9,825**	**$6,989**

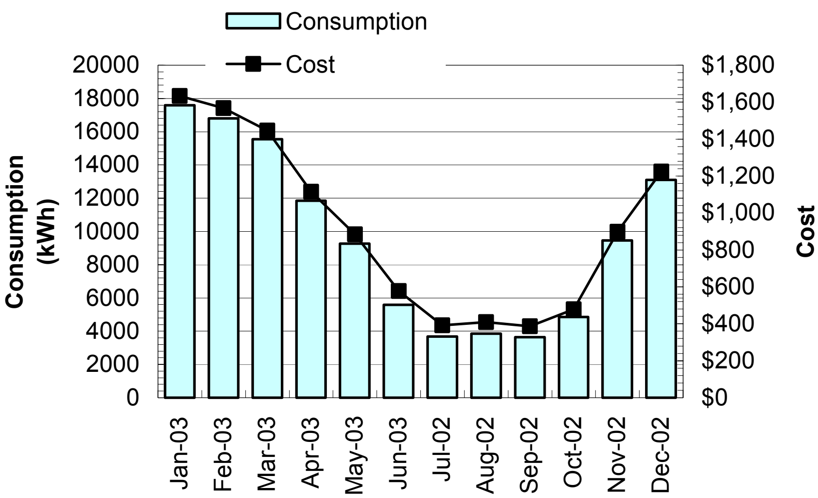
Cost/sq.ft.:	$0.46	per sq.ft./yr.
Gas EUI:	**65,927**	**BTU/sq.ft.**
Avg. Cost:	$0.711	/ CCF

Annual Utility Cost = $19,999
Total Cost / sq.ft. = $1.30
Combined EUI = 98,058

Bus Garage / Maintenance

Square Ft	4,000	**Wall Construction**	steel, no insulation	**Heating**	(2) ceiling gas units, Res. Fur
Year Built		**Roof Construction**	steel, no insulation	**Cooling**	(2) Window DX units
Additions		**Windows**	double Pane	**Distribution**	Forced air
DHW	tank, gas	**Interior Lighting**	T-12, MH	**Temp Cont.**	pneumatic t-stats
		Exterior Lighting	HPS, MV	**Other**	

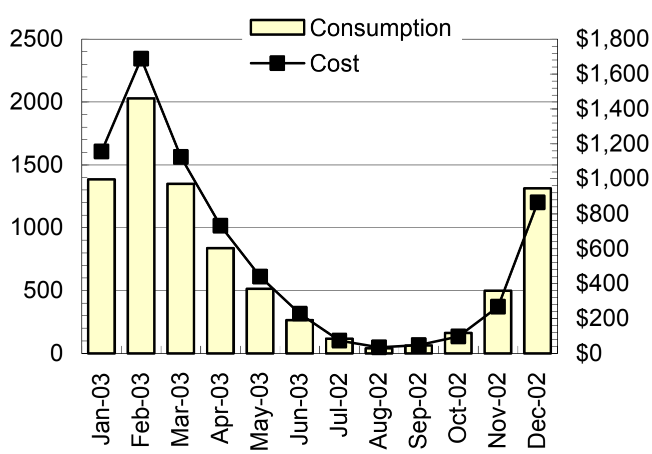
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	17,591	$1,634
Feb-03	16,803	$1,568
Mar-03	15,556	$1,447
Apr-03	11,850	$1,116
May-03	9,268	$885
Jun-03	5,583	$577
Jul-02	3,678	$392
Aug-02	3,846	$409
Sep-02	3,633	$387
Oct-02	4,848	$478
Nov-02	9,457	$899
Dec-02	13,100	$1,224
Totals:	**115,213**	**$11,015**

Cost/sq.ft.: $2.75 per sq.ft./yr.
Elec EUI: 98,305 BTU/sq.ft.
Avg. Cost: $0.096 /kWh

Natural Gas Consumption Profile



Month	CCF	Cost
Jan-03	1,386	$1,157
Feb-03	2,030	$1,687
Mar-03	1,349	$1,126
Apr-03	837	$731
May-03	515	$439
Jun-03	265	$228
Jul-02	117	$74
Aug-02	41	$36
Sep-02	64	$47
Oct-02	163	$97
Nov-02	500	$267
Dec-02	1,314	$865
Totals:	**8,581**	**$6,754**

Cost/sq.ft.: $1.69 per sq.ft./yr.
Gas EUI: 220,961 BTU/sq.ft.
Avg. Cost: $0.787 / CCF

Annual Utility Cost = $17,770
Total Cost / sq.ft. = $4.44
Combined EUI = 319,266